



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

August 25, 2020

MEMORANDUM TO: Hipolito Gonzalez, Chief
Vessels and Internals Branch
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

FROM: Carolyn Fairbanks, Senior Materials Engineer */RA/*
Vessels and Internals Branch
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

SUBJECT: SUMMARY OF THE JULY 30, 2020, CATEGORY 2 PUBLIC
MEETING ON REVISION 1 OF THE ADVANCED
MANUFACTURING TECHNOLOGIES ACTION PLAN AND
GUIDANCE FRAMEWORK

The U.S. Nuclear Regulatory Commission (NRC) staff from the Office of Nuclear Reactor Regulation (NRR) and the Office of Nuclear Regulatory Research (RES) held a meeting on July 30, 2020, to present Revision 1 of the Advanced Manufacturing Technologies (AMT) Action Plan and draft outline of Subtask 2C on the development of an AMT guidance framework. The NRC requested industry and public feedback on the AMT guidance framework.

The agenda, AMT Action Plan Revision 1 presentation, AMT Guidance Framework presentation, and AMT Guidance Framework Discussion and Examples presentation for the meeting are available in the NRC's Agencywide Documents Access and Management System (ADAMS) under Accession Numbers ML20202A403, ML20213B613, ML20204A868, and ML20233A824 respectively. A list of the meeting participants is enclosed.

A summary of the meeting's discussions follows by agenda topic.

1. Introduction and Opening Remarks

The NRC staff welcomed the participants and covered administrative items for the meeting. Anna Bradford, the Director of the New and Renewed Licenses from the NRC Office of Nuclear Reactor Regulation, delivered opening remarks. She provided a brief introduction to AMTs in relation to its potential for application at operating power plants and advanced nuclear reactors and discussed the objectives and scope of the NRC AMT Action Plan. She discussed the purpose of the NRC staff presentation regarding Revision 1 to the AMT Action Plan. She also outlined the presentation

CONTACT: Carolyn Fairbanks, NRR/DNRL
301-415-6719

on the proposed framework developed by the NRC staff that describes the generic technical information to be addressed in AMT submissions. She indicated that this framework will provide the foundation of a report that will identify broad areas where AMT technology deviates from traditional manufacturing, consider safety, risk-informed and performance-based perspectives, and will serve as the starting point for discussions with AMT users regarding the information that is needed for the review of AMT submittals. She expressed the NRC staff interest in receiving feedback from external stakeholders regarding the framework.

2. NRC Staff Presentation – AMT Action Plan Revision 1

The NRC staff presentation (ADAMS Accession No. ML20202A403) focused on a discussion and status update of the objectives and tasks in the AMT Action Plan, Revision 1. The NRC staff began with a brief discussion of AMTs as defined within the NRC perspective, as well as a brief history and the focus of the AMT Action Plan. The NRC staff then detailed the specific objectives of Revision 1 to the AMT Action Plan, which includes assessing safety significant differences between AMTs and traditional manufacturing for those AMTs most likely to be used in near-term nuclear applications; preparing the NRC staff to address use of AMT components under the 10 CFR 50.59 process; identifying and addressing AMT characteristics pertinent to safety but not managed or addressed by existing codes, standards, regulations, or guidance; providing guidance and tools for review consistency, communication, and knowledge management to support AMT reviews; and providing transparency to stakeholders on the process for AMT approvals.

The NRC staff then discussed the three major tasks within the Action Plan. The staff explained that the purpose of Task 1 is to address technical preparedness by gaining technical information, knowledge, and tools to prepare the staff to review AMT submittals. The purpose of Task 2 is to address regulatory preparedness by developing regulatory guidance and tools to prepare staff for efficient and effective review of AMT-fabricated components. The purpose of Task 3 is to support communications and knowledge management with the integration of information from external organizations into the NRC staff knowledge base, external interactions, and knowledge sharing. The staff then provided additional details on the subtasks within each task. The NRC staff summarized these tasks by presenting a flowchart which depicts the interactive nature of the AMT Action Plan tasks. The NRC staff continued the presentation by providing a table that shows the deliverables and respective date. The staff provided a few additional details regarding each deliverable. The Subtask 2B deliverable was completed prior to the meeting, through a May 2020 email from the NRC staff to NRC Division Directors that discusses the staff assessment of the need for regulatory guidance for AMTs and is available in ADAMS under Accession No. ML20233A693.

The NRC staff then discussed a public workshop on AMTs for nuclear applications, which is tentatively scheduled for December 7-10, 2020. The purposes of this public workshop are to discuss ongoing activities related to AMTs, including nuclear industry implementation plans, codes and standards activities, research findings, and regulatory approaches in other industries; to inform the public of NRC's activities and approach for approving use of AMTs; and to determine, with input from nuclear industry stakeholders

and other technical organizations, areas where NRC should focus to ensure safe implementation of AMTs. The NRC staff provided a tentative workshop agenda that included presentations from both the NRC staff and external stakeholders. The NRC staff then continued by discussing other future interactions and meetings with external stakeholders. The future interactions are a public meeting on Subtask 2A, which will discuss the draft NRC document for public comment on applying 10 CFR 50.59 when implementing an AMT-fabricated component, and a public meeting on Subtask 2C, which will discuss the draft NRC guidance document on the application guidance framework that will be discussed in the second part of this public meeting. These public meetings are both tentatively planned for September 2020.

At the conclusion of the NRC staff's presentation, external stakeholder feedback was requested.

3. NRC-Industry Discussion - AMT Action Plan Revision 1

There were two members from the industry who provided comments during this portion of the meeting. The first member asked for additional clarification on Subtask 2A and the document the staff is developing regarding 10 CFR Part 50.59, particularly with regards to how this document will be different from existing guidance. The staff responded that this document will be closer to a white paper that is intended to provide guidance to NRC inspectors who are reviewing a licensee's AMT evaluation as part of a 10 CFR Part 50.59 audit. The second member provided a comment that Nuclear Energy Institute (NEI) published a very helpful guideline document for the 10 CFR Part 50.59 process. The staff responded by noting that the NEI document was reviewed and was considered when developing the staff document.

4. NRC Staff Presentation – AMT Application Guidance Draft Framework

The NRC staff's presentation (ADAMS Accession No. ML20204A868) focused on the NRC AMT Application Guidance Framework (ADAMS Accession No. ML20203M254). The NRC staff stated that this draft framework provides a starting point for discussion on potential guidance regarding the use of AMTs and stated that the AMTs include techniques and material processing methods not traditionally used in the US nuclear industry that have yet to be formally standardized by the nuclear industry and approved by the NRC. The NRC staff articulated the general philosophy that the framework and associated guidance must be sufficient and flexible. The NRC staff stated that there are currently two conventional paths to demonstrating that an AMT component is acceptable and will fulfill its intended function: an equivalency approach and a design modification.

The NRC staff continued its presentation by discussing the regulatory pathways for implementing AMT components. Of the four regulatory pathways that were discussed, the NRC staff provided additional details and examples of the 10 CFR Part 50.55a, "Codes and Standards," regulatory pathway, specifically 10 CFR Part 50.55a(z), "Alternatives to Codes and Standards Requirements." The NRC staff described how a licensee's implementation of an AMT component can be processed through 10 CFR Part 50.55a(z)(1) and 10 CFR Part 50.55a(z)(2), and provided a detailed example of each alternative.

Next, the NRC staff discussed the process flow chart, which is Appendix A to the AMT Application Guidance Framework, and stated that this flow chart describes a holistic approach to the qualification and performance considerations for any system, structure, (SSC) or safety significant component, including the underlying material and fabrication process. The NRC noted that: 1) the flow chart is intended to cover a broad range of AMTs and to be a guide which outlines the types of information that could be included in a licensee's request to facilitate the NRC's review, 2) depending on the AMT process used, some of the information in the flow chart may not be necessary, 3) the focus of the information provided should be on those unique attributes associated with AMT qualification and performance compared to conventionally manufactured SSCs, and 4) the application may leverage relevant aspects of American Society of Mechanical Engineers (ASME) Code and ASTM International standards that prescribe certain testing requirements for conventionally manufactured items. The NRC staff conducted a walk through to demonstrate how the flow chart can be used. This walk through provided a detailed discussion of the major aspects of the process flow chart: Quality Assurance, Processing (including Process Qualification and Process Control), Product Evaluation, and Performance Monitoring. For each of these aspects, the NRC staff provided the definition, important details, and examples of specific information that can be used to demonstrate that the aspect has been adequately addressed.

At the conclusion of the NRC staff's presentation, external stakeholder feedback was requested.

5. NRC-Industry Discussion – AMT Application Guidance Draft Framework

To kick-off the Discussion portion of the agenda, the NRC staff provided a presentation (ADAMS Accession No. ML20233A824) to provide examples of how the AMT application guidance draft framework and flow chart can be used. The NRC staff conducted a walkthrough of two examples, laser powder bed fusion and cold spray. For each example, the NRC staff highlighted the acceptability pathways and regulatory pathways, as discussed in the previous NRC presentation, and noted that the focus should be on unique technical attributes associated with AMTs as compared to conventionally manufactured components. The NRC staff further noted that development of consensus codes and standards are extremely helpful, that the level of detail in application is directly related to complexity and maturity of the proposed AMT and the safety significance of the SSC, and that some AMTs may require detail in all process flowchart areas, while other may only need minimal information. The NRC staff provided this presentation to help facilitate external stakeholder feedback and a more active discussion.

The industry noted that they would like to receive additional clarification regarding the AMT guidance. In particular, the industry wanted to understand when they would need to exercise the guidance, what level of detail (or effort) is needed, what is the definition of unique AMT characteristics and what is the threshold for triggering an evaluation of the differences between these unique characteristics and a conventional approach. The staff responded by indicating that the question is difficult to generically answer because it is highly dependent on the process, component, and safety significance. The staff

noted that the level of specificity provided in the guidance may impact the overall flexibility.

The industry asked the NRC how they can leverage AMT knowledge from other industries. The NRC staff noted that the AMT Action Plan addresses knowledge in these other areas. The staff further noted that the most effective time to discuss such information may be during pre-submittal meetings.

One external stakeholder noted that, using metal additive manufacturing, parts can be produced that are geometrically accurate but have unexpected mechanical properties. They further noted that process control can help with that issue, but unexpected engineering defects may still occur. The industry commenter asked the NRC staff, based upon this situation, if it would be acceptable to implement in-situ defect correction for nuclear components. The NRC staff stated that this practice would be possible in theory and noted that this is not dissimilar to repairing weld defects in traditional manufacturing.

One external stakeholder asked the NRC staff if they have reviewed the approach provided in ASTM standards related to laser powder bed fusion and if that would be an acceptable approach for other alloys. The NRC staff noted that for the powder metallurgy – hot isostatic pressing ASME Code Case, the staff identified details which were incorporated into the code case. The staff further noted that this AMT is a very mature technology and would consider something similar for other AMTs.

One industry commenter requested additional details regarding lifecycle testing and if it would be component-specific or AMT process-specific. The NRC staff noted that lifecycle testing would not necessarily be a requirement but could be used to demonstrate acceptability over the life of a component. The NRC staff noted that it can be applicable to both components and AMT-specific processes, and that long-term concerns, such as stress corrosion cracking, could be more generally addressed.

One industry member commented that they appreciated the level of guidance presented in the Action Plan, noting the importance that it is not too prescriptive yet contains sufficient detail to allow a submitter to understand what is needed in an application.

One industry commenter asked if the NRC provides avenues for industry interactions in a non-public environment. The NRC responded by stating there are paths for holding closed public meetings to discuss, for example, proprietary information. These meetings are still noticed on the NRC public site. Additional information about closed public meetings can be found on the NRC Public Meeting FAQ on its public site (which includes a link to the NRC's policy on "Enhancing Public Participation in NRC Meetings"): <https://www.nrc.gov/public-involve/public-meetings/meeting-faq.html>.

One external stakeholder asked what the NRC position is on the potential for new materials (e.g., functionally graded materials) that are designed specifically for AMT fabrication to improve material performance over conventional materials. The NRC staff stated that the AMT Application Guidance Draft Framework would be applicable to new materials and there is no difference in process as long as it is demonstrated that the

applicable requirements, regulations, and design criteria are met. The NRC staff noted that they are open to proposals from the industry.

One industry commenter asked if the NRC would be receptive to accepting temporary field repairs using cold spray, assuming adequate examination and monitoring would be applied. The industry commenter also asked if the proposed frameworks applies to this situation. The NRC staff noted that pre-submittal meetings would be important to discuss to the applicable aspects regarding this situation. The NRC staff further noted that if pre-approval is requested, then the topical report process or the ASME Code Case process are available.

One industry commenter requested clarification on if this potential framework would apply to both advanced reactors and the existing fleet. The NRC clarified that it would apply to both.

6. Public Comment

No public comments were received during this public meeting.

7. Closing Remarks

The NRC staff concluded the meeting with closing remarks from Hipolito Gonzalez, the Branch Chief of the Vessels and Internals Branch in the Division of New and Renewed Licenses from the NRC Office of Nuclear Reactor Regulation. Mr. Gonzalez thanked the NRC staff for their presentation and thanked all participants for their discussion and insight. Finally, the NRC staff encouraged participants to submit any feedback on the format of this meeting.

Enclosure:
As stated

SUBJECT: SUMMARY OF THE JULY 30, 2020, CATEGORY 2 PUBLIC MEETING ON REVISION 1 OF THE ADVANCED MANUFACTURING TECHNOLOGIES ACTION PLAN AND GUIDANCE FRAMEWORK DATED AUGUST 25, 2020

DISTRIBUTION:

PUBLIC
DNRL/NRR
NVIB/DNRL/NRR
NPHB/DNRL/NRR
DE/RES
CIB/DE/RES
CMB/DE/RES

ADAMS Accession Number: ML20240A077

***via email**

OFFICE	NRR/DNRL/NVIB
NAME	CFairbanks
DATE	08/25/2020

OFFICIAL RECORD COPY

ENCLOSURE

U.S. Nuclear Regulatory Commission Category 2 Public Meeting to Revision 1 of the Advanced Manufacturing Technologies (AMT) Action Plan and AMT Application Guidance Draft Framework

July 30, 2020
Participant List

Full Name	Affiliation
Marc Albert	EPRI
Brian Allik	NRC
Clinton Armstrong	Westinghouse
Margaret Audrain	NRC
Jana Bergman	Curtiss Wright
Anna Bradford	NRC
Sherri Buchanan	ORNL
Mike Burke	EPRI
Grace Burke	University of Manchester
Augi Cardillo	NuScale
Yiren Chen	ANL
Ganesh Cheruvenki	NRC
Jason Christensen	INL
William Clearly	Westinghouse
Edward Coulter	TVA
Robert Davis	NRC
Ernie Dee	External Stakeholder
Ryan Dehoff	ORNL
David Dijamco	NRC
Alkan Donmez	NIST
Darrell Dunn	NRC
Bhaskar Dutta	DM3D Technology
Carolyn Fairbanks	NRC
John Fasnacht	Westinghouse
Eric Focht	NRC
Istvan Frankl	NrC
Lee Friant	Exelon
Travis Fritts	BWXT
Daniel Galicki	BWXT
Donna Gilmore	External Stakeholder
Hipolito Gonzalez	NRC
David Hinds	GE
Allen Hiser	NRC
Matthew Hiser	NRC
David Huegel	Westinghouse
Amy Hull	NRC
Alex Huning	ORNL
Brian Hunt	PCC-York
Raj Iyengar	NRC
Richard Jacob	PNNL
Saamyadeep Jana	PNNL

Vineet Joshi	PNNL
Pierre-Alexander Juan	Kairos Power
Hilary Lane	NEI
John Iareau	PNNL
Meimei Li	ANL
Bruce Lin	NRC
Chris Lohse	Structural Integrity
Shah Malik	NRC
Mike McMurtrey	INL
James Medoff	NRC
Mark Messner	ANL
Ed Miller	NRC
Carol Moyer	NRC
Shawn Moylan	NIST
Aaron Nardi	US Army
Marc Nichol	NEI
Carol Nove	NRC
Vincent Paquit	ORNL
Dong Park	NRC
Raju Patel	NRC
Per Peterson	Kairos Power
Patrick Purtscher	NRC
Wendy Reed	NRC
Ali Rezai	NRC
David Rudland	NRC
Ryann Rupp	INL
Michael Russell	ORNL
Steve Schilthelm	BWXT
Alyssa Schneider	NRC
Farshid Shahrokhi	Framatome
Sam Sham	ANL
Todd Sherman	Entergy
Jeffrey Shoup	Westinghouse
Jeff Simmons	Toshiba
Joseph Simpson	ORNL
James Stouch	PCC-York
Craig Stover	EPRI
Pushpal Swarnkar	Kairos Power
Kurt Terrani	ORNL
Rob Tregoning	NRC
John Tsao	NRC
Mark Vance	ORNL
Yanli Wang	ORNL
Dan Widrevitz	NRC
Brad Williams	EPW
Chris Wiltz	Framatome
John Wise	NRC
Mark Yoo	NRC
Xuan Zhang	ANL